

**SEARCH REQUEST FORM****Scientific and Technical Information Center**

Requester's Full Name: Melanie Bissett Examiner #: 77899 Date: 7/18/03  
 Art Unit: 1711 Phone Number 303-6539 Serial Number: 09/890878  
 Mail Box and Bldg/Rm Location: C03 4D35 Results Format Preferred (circle): PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc., if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Polyimides Used As Microelectronic Coatings

Inventors (please provide full names): Frank W. Harris, Stephen Z.D. Cheng

Earliest Priority Filing Date: 1/29/99

\*For Sequence Searches Only\* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.

Please search the polyimide reactant structures of claim 1. Any acronyms for reactants have been given. I have found one good ref. for a combination of III and IV (US 5324813) but have not found a combination of I and II.

Thank you!

**STAFF USE ONLY**

Searcher: E.L.

Searcher Phone #:

Searcher Location:

Date Searcher Picked Up:

Date Completed: 7-18-03

Searcher Prep & Review Time: 5

Clerical Prep Time:

Online Time: 65

**Type of Search**

NA Sequence (#) STN: \$197.91

AA Sequence (#) Dialog

Structure (#) (2) Questel/Orbit

Bibliographic (and) Link

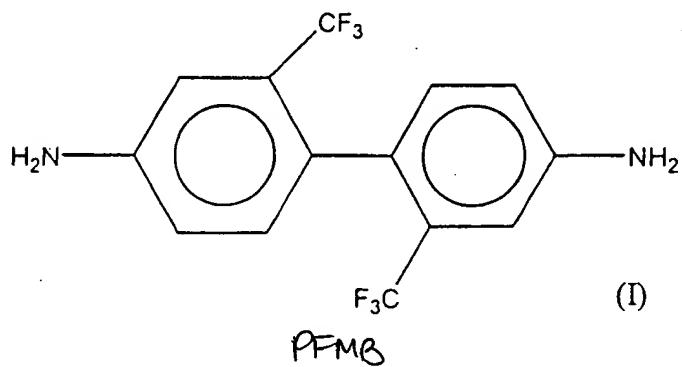
Litigation Lexis/Nexis

Fulltext Sequence Systems

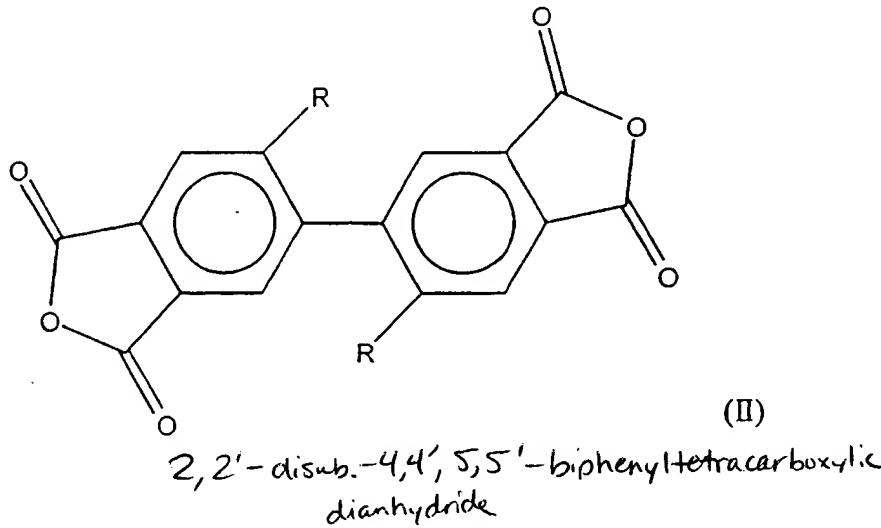
Patent Family WWW/Internet

Other Other (specify)

WE CLAIM:

1. An insulated integrated circuit comprising:an integrated circuit; and5 an insulating layer disposed on said integrated circuit, wherein said insulating layer is a polyimide film that is the polymerization product of polymerization product of an aromatic diamine having the general formula (I):

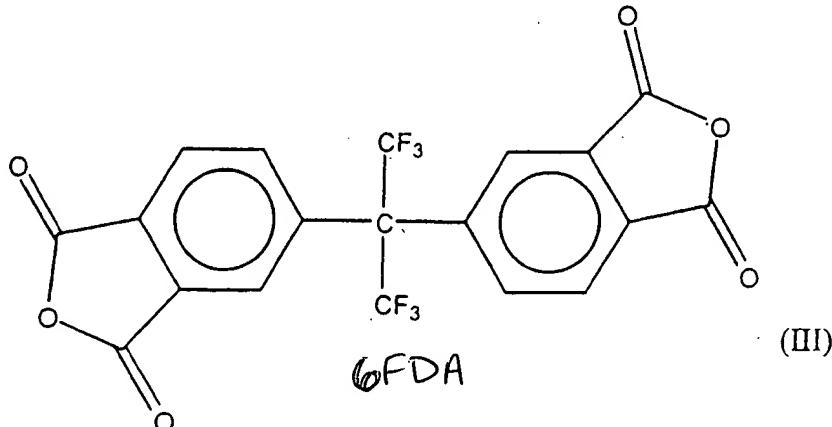
10 and an aromatic dianhydride having the formula (II):



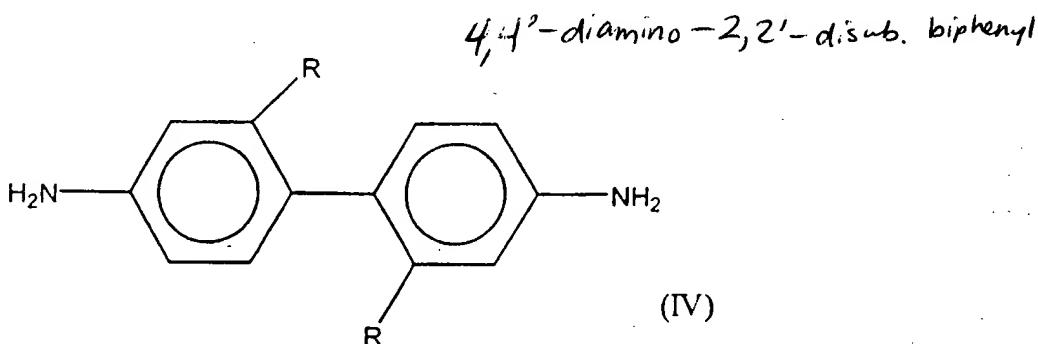
wherein R is an organic substituent selected from the group consisting of  $\text{CF}_3$ , o-trifluoromethyl phenyl, m-trifluoromethyl phenyl, p-trifluoromethyl phenyl and 3,5-bis[(m-trifluoromethyl) phenyl], or

5 the polymerization product of an aromatic dianhydride having the general formula

(III):

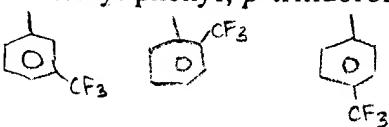


and an aromatic diamine having the formula (IV):



10

wherein R is a substituent selected from the group consisting of trifluoromethyl, o-trifluoromethyl phenyl, m-trifluoromethyl phenyl, p-trifluoromethyl phenyl and 3,5-bis[(m-trifluoromethyl) phenyl].



15

2. The insulated integrated circuit according to claim 1 wherein said integrated circuit is a microprocessor.

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FILE 'REGISTRY' ENTERED AT 16:01:26 ON 18 JUL 2003  
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FILE 'LREGISTRY' ENTERED AT 15:32:08 ON 18 JUL 2003

L1 STR  
L2 STR

FILE 'REGISTRY' ENTERED AT 15:40:44 ON 18 JUL 2003

L3 SCR 2043  
L4 1 S L1 AND L2 AND L3  
L5 77 S L1 AND L2 AND L3 FUL  
SAV L5 BIS378/A  
L6 14 S L5 AND 2/NC  
L7 636993 S CLH OR H2O4S OR HNO3 OR H3O4P  
L8 0 S L5 AND L7

FILE 'ZCAPLUS' ENTERED AT 15:45:13 ON 18 JUL 2003

L9 177 S L6

FILE 'REGISTRY' ENTERED AT 15:49:35 ON 18 JUL 2003

SEL L6 1 RN  
L10 1 S E1  
SEL L6 2 RN  
L11 1 S E2  
SEL L6 3 RN  
L12 1 S E3  
SEL L6 4 RN  
L13 1 S E4  
SEL L6 5 RN  
L14 1 S E5  
SEL L6 6 RN  
L15 1 S E6  
SEL L6 7 RN  
L16 1 S E7  
SEL L6 8 RN  
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L19 1 S E10  
SEL L6 14 RN  
L20 1 S E11

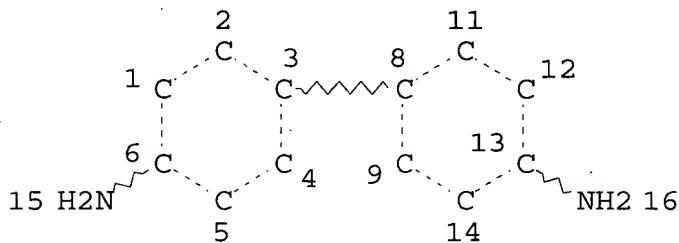
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L26	3 S L15
L27	3 S L16
L28	3 S L17
L29	7 S L18
L30	5 S L19
L31	169 S L20
L32	14 S L21-L30
L33	261566 S INSULAT?
L34	7 S L31 AND L33
L35	6 S L34 NOT L32

FILE 'REGISTRY' ENTERED AT 16:01:26 ON 18 JUL 2003

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L1 STR  
CF3 19

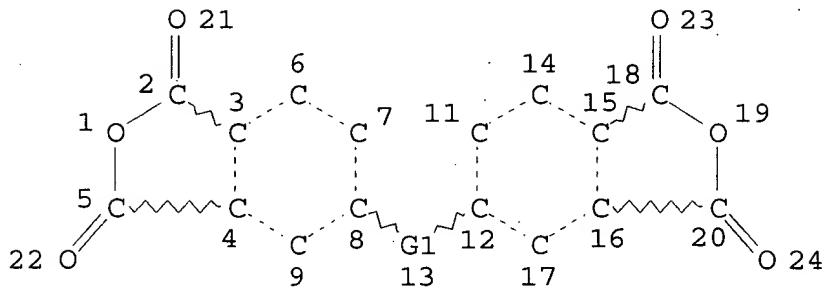


NODE ATTRIBUTES:  
DEFAULT MLEVEL IS ATOM  
DEFAULT ECLEVEL IS LIMITED

GRAPH ATTRIBUTES:  
RING(S) ARE ISOLATED OR EMBEDDED  
NUMBER OF NODES IS 15

STEREO ATTRIBUTES: NONE  
L2 STR

CF3 27



REP G1=(0-1) C

NODE ATTRIBUTES:

DEFAULT MLEVEL IS ATOM

DEFAULT ECLEVEL IS LIMITED

GRAPH ATTRIBUTES:

RING(S) ARE ISOLATED OR EMBEDDED

NUMBER OF NODES IS 24

STEREO ATTRIBUTES: NONE

L3 SCR 2043

L5 77 SEA FILE=REGISTRY SSS FUL L1 AND L2 AND L3

100.0% PROCESSED 634 ITERATIONS

77 ANSWERS

SEARCH TIME: 00.00.01

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FILE 'ZCA' ENTERED AT 16:01:51 ON 18 JUL 2003

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=&gt; d 135 1-6 cbib abs hitstr hitind

L35 ANSWER ① OF 6 ZCA COPYRIGHT 2003 ACS

136:201308 Curable low dielectric constant polymer compositions with good heat and solvent resistance and transparency. Fujiwara, Takenori; Mori, Yoichi (Toray Industries, Inc., Japan). Jpn. Kokai Tokkyo Koho JP 2002056718 A2 20020222, 10 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 2000-239650 20000808.

AB The compns. useful for elec. insulation, contain F-contg. polyamic acids or polyimides and compds. with .gtoreq.3 allyl groups. Thus, heating a mixt. of 2,4-diamino-1,5-bis[3,5-bis(trifluoromethyl)phenoxy]benzene 5.72 in NMP 16.0 and 2,2-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride 4.44 in

NMP 7.6 g at 50.degree. for 6 g, adding the resulting mixt. into 400 mL water, mixing for 1 day, filtering and drying the ppt. gave a polyamic acid with Mn 40,000, 4 g of which was dissolved with cyclohexanone 4.2 in NMP 1.8; combined with triallyl cyanurate 1.6 g, filtered, spin coated on an Al plate and baked to give a dielec. film with relative permittivity 2.31.

IT 129197-26-8P

(curable low dielec. const. polymer compns. with good heat and solvent resistance and transparency)

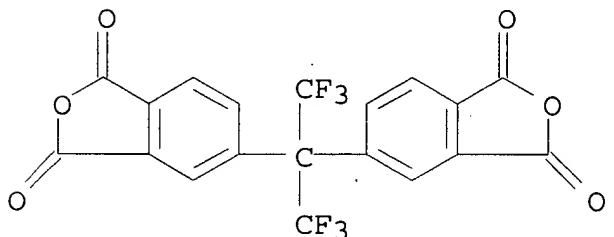
RN 129197-26-8 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

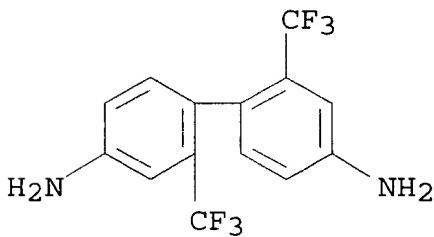
CMF C19 H6 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IC ICM H01B003-30

ICS H01B003-30; C08L079-08

CC 38-3 (Plastics Fabrication and Uses)

Section cross-reference(s): 76

IT 129197-26-8P 129219-42-7P 302899-90-7P

(curable low dielec. const. polymer compns. with good heat and

solvent resistance and transparency)

L35 ANSWER 2 OF 6 ZCA COPYRIGHT 2003 ACS

134:132597 Electrically **insulating** polymer compositions having excellent heat resistance. Fujiwara, Takenori; Mori, Yoichi (Toray Industries, Inc., Japan). Jpn. Kokai Tokkyo Koho JP 2001019765 A2 20010123, 12 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 1999-191404 19990706.

AB Title compns. comprise polymers terminated with H<sub>2</sub>NC<sub>6</sub>H<sub>5</sub>-nRn (R = F, Rf, ORf; Rf = fluoro-contg. C<sub>1</sub>-20 monovalent org. group; n = 1-5). Thus, 2,2'-bistrifluoromethyl-4,4'-diaminodiphenyl was polymd. with 2,2-bis(3,4-dicarboxyphenyl)-1,1,1,3,3,3-hexafluoropropane dianhydride in the presence of 3,5-bistrifluoromethylaniline to give a varnish contg. polyamic acid, which was applied on a plate and cured to give a film showing dielec. const. .epsilon. 2.68 (1 kHz) and 5% wt. loss temp. 538.degree..

IT 129197-26-8DP, reaction products with 3,5-bistrifluoromethylaniline

(heat-resistant polyimides for elec. insulating films)

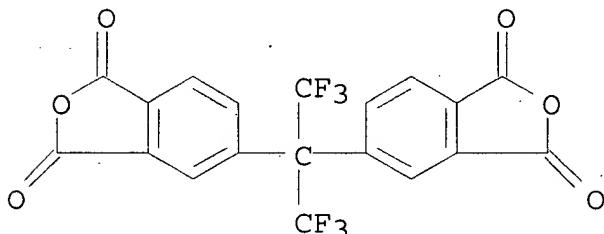
RN 129197-26-8 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

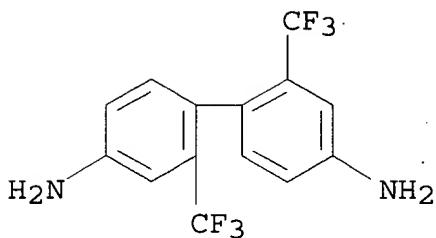
CMF C19 H6 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IC ICM C08G073-10  
 ICS C07C211-52

CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 76

ST elec **insulating** film polyimide; dielec film polyimide heat resistance

IT Polyamic acids  
 (fluorine-contg.; heat-resistant polyimides for elec.  
**insulating** films)

IT Polyimides, uses  
 (fluorine-contg.; heat-resistant polyimides for elec.  
**insulating** films)

IT Dielectric films  
 Electric **insulators**  
 (heat-resistant polyimides for elec. **insulating** films)

IT Fluoropolymers, uses  
 (polyamic acid-; heat-resistant polyimides for elec.  
**insulating** films)

IT Fluoropolymers, uses  
 (polyimide-; heat-resistant polyimides for elec.  
**insulating** films)

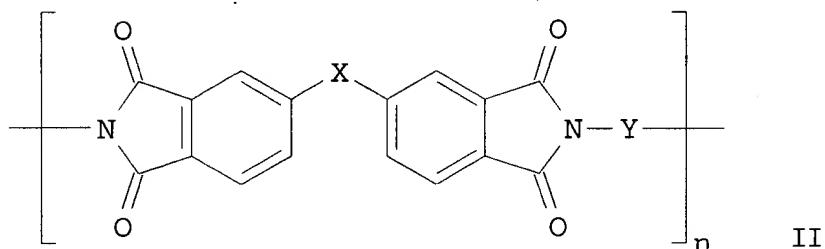
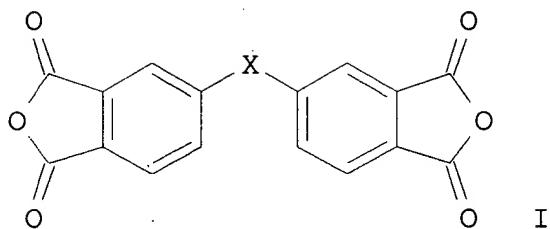
IT 98-16-8DP, 3-Trifluoromethylaniline, reaction products with polyimides 321582-33-6DP, reaction products with 3-trifluoromethylaniline 321582-34-7DP, reaction products with 3,5-bistrifluoromethylaniline  
 (dendritic; heat-resistant polyimides for elec.  
**insulating** films)

IT 132729-01-2DP, reaction products with 3,5-bistrifluoromethylaniline  
 (heat-resistant polyimides for elec. **insulating** films)

IT 328-74-5DP, 3,5-Bistrifluoromethylaniline, reaction products with diaminodiphenyl-bis(dicarboxyphenyl)propane copolymer  
 129197-26-8DP, reaction products with 3,5-bistrifluoromethylaniline 321582-32-5P  
 (heat-resistant polyimides for elec. **insulating** films)

L35 ANSWER ③ OF 6 ZCA COPYRIGHT 2003 ACS

133:127657 Thin-film transistor liquid crystal display device. Sasaki, Nobuhiko; Ueda, Mitsuru (Alps Electric Co., Ltd., Japan). Jpn. Kokai Tokkyo Koho JP 2000206509 A2 20000728, 7 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 1999-11214 19990119.



AB The device has a liq. crystal layer sandwiched between a pair of substrates, one of which is coated with an interlayer **insulating** film comprising a fluorinated polyimide (imidation ratio 66-90%) contg. a repeating unit having a formula I ( $n = 50-1000$  integer) manufd. from a fluorinated carboxylic anhydride II [ $X = C(CF_3)_2, CO_2(CF_2)_2CO_2, Si(CF_3)_2CSi(CF_3)_2$ ] and an arom. diamine  $NH_2YNH_2$  ( $Y = O, NH_2-Ph-p-O-Ph-p-NH_2, NH_2-Ph-p-NH_2$ ). The film shows low dielectricity, high light transmittance, and improved adhesion to an upper electrode. The device shows high aperture.

IT **129197-26-8P**

(TFT liq. crystal display device having fluorinated polyimide-based interlayer **insulating** film)

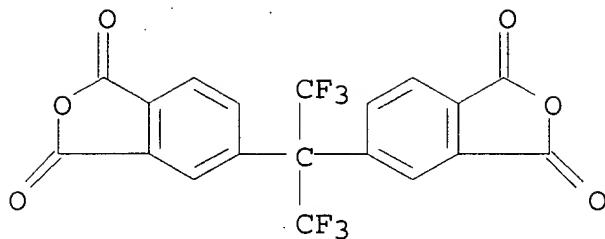
RN 129197-26-8 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

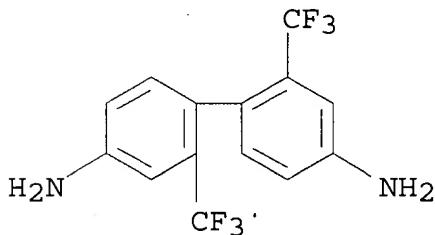
CMF C19 H6 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IC ICM G02F001-1333  
 ICS C08G073-10; H01L021-312; H01L029-786; C09D179-08; C09J179-08  
 CC 74-13 (Radiation Chemistry, Photochemistry, and Photographic and Other Reprographic Processes)  
 Section cross-reference(s): 38, 76  
 ST TFT liq crystal display **insulating** film; fluorinated polyimide interlayer **insulating** film LCD; arom diamine fluorinated carboxylic anhydride **insulator**  
 IT Dielectric films  
 Liquid crystal displays  
 Thin film transistors  
 (TFT liq. crystal display device having fluorinated polyimide-based interlayer **insulating** film)  
 IT Polyimides, uses  
 (TFT liq. crystal display device having fluorinated polyimide-based interlayer **insulating** film)  
 IT 32240-73-6P 40921-63-9P **129197-26-8P**  
 (TFT liq. crystal display device having fluorinated polyimide-based interlayer **insulating** film)

L35 ANSWER ④ OF 6 ZCA COPYRIGHT 2003 ACS

131:287439 Polymer film with low dielectric constant, formation thereof, and interlayer **insulating** film of semiconductor device.  
 Iishima, Masayuki; Sato, Masatoshi; Ukishima, Sadashi; Takahashi, Yoshikazu; Sasaki, Shigekuni; Matsuura, Toru; Yamamoto, Fumio (ULVC

Japan, Ltd., Japan; Nippon Telegraph and Telephone Corp.; NTT Advanced Technology K. K.). Jpn. Kokai Tokkyo Koho JP 11283974 A2 19991015 Heisei, 10 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 1998-100273 19980327.

AB The title polymer film formed on a substrate using vapor deposition contains a predetd. amt. of F. The polymer film may be a polyimide contg. F > 25%. This polymer film may be used as an interlayer **insulating** film of a semiconductor device.

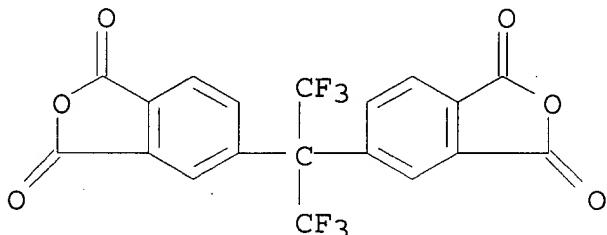
IT **129197-26-8P**  
(prepn. of polyimide film having low dielec. const. for interlayer **insulating** film of semiconductor device)

RN 129197-26-8 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

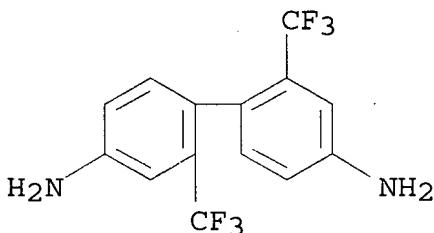
CM 1

CRN 1107-00-2  
CMF C19 H6 F6 O6



CM 2

CRN 341-58-2  
CMF C14 H10 F6 N2



IC ICM H01L021-312  
ICS B32B027-00; C08G073-10; C08G085-00; C08J005-18; H01B003-24;  
H01B003-30; H01L021-768; B32B007-02; C23C014-12  
CC 38-3 (Plastics Fabrication and Uses)

ST Section cross-reference(s) : 76  
 fluorinated polyimide interlayer **insulating** film;  
 semiconductor device dielec film

IT Dielectric films  
 Vapor deposition process  
 (prepn. of polyimide film having low dielec. const. for  
 interlayer **insulating** film of semiconductor device)

IT Polyamic acids  
 (prepn. of polyimide film having low dielec. const. for  
 interlayer **insulating** film of semiconductor device)

IT Polyimides, uses  
 (prepn. of polyimide film having low dielec. const. for  
 interlayer **insulating** film of semiconductor device)

IT 129197-24-6P 129197-26-8P 129219-40-5P 129219-42-7P  
 246245-33-0P 246245-34-1P 246245-35-2P 246245-36-3P  
 (prepn. of polyimide film having low dielec. const. for  
 interlayer **insulating** film of semiconductor device)

L35 ANSWER 5 OF 6 ZCA COPYRIGHT 2003 ACS

118:126105 Transparent and low dielectric constant multilayer polyimide films and their manufacture. Sasaki, Shigekuni; Ando, Shinji; Matsura, Toru (Nippon Telegraph and Telephone Corp., Japan). Jpn. Kokai Tokkyo Koho JP 04235034 A2 19920824 Heisei, 7 pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 1991-12436 19910110.

AB The title films are prep'd. by applying polyamic acid solns. onto solvent-sol. (but not sol. in the same solvent which dissolves the polyamic acid) polyimide films and curing. Thus, a laminate was prep'd. by applying 2,2'-bis(trifluoromethyl)-4,4'-diaminobiphenyl (I)-2,2-bis(3,4-dicarboxyphenyl) hexafluoropropane dicarboxylic dianhydride (II) polyamic acid in Me iso-Bu ketone (III) soln. onto I-II copolymer film (not sol. in III) and curing at 350.degree..

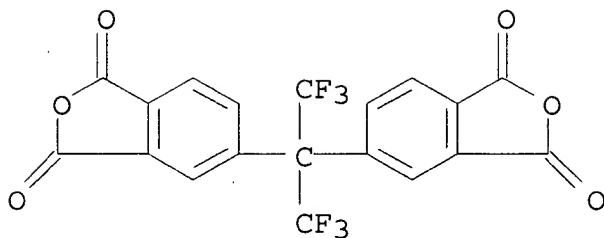
IT 129197-26-8P  
 (laminates, transparent and dielec., prepn. of)

RN 129197-26-8 ZCA

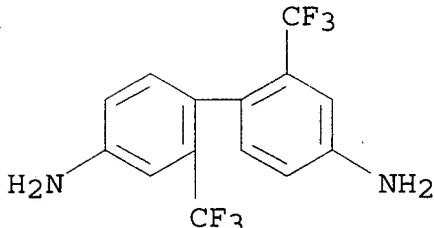
CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2  
 CMF C19 H6 F6 O6



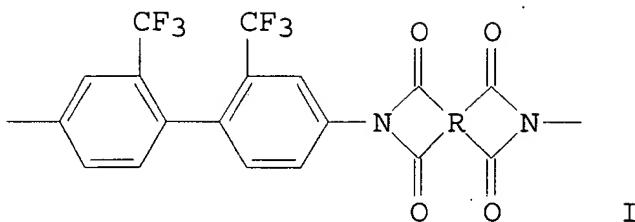
CM 2

CRN 341-58-2  
CMF C14 H10 F6 N2

IC ICM B32B027-00  
ICS B29C041-12; B32B031-00; C08G073-10; C08J005-18; C09D179-08  
ICI B29K079-00, B29L009-00, C08L079-08  
CC 38-3 (Plastics Fabrication and Uses)  
Section cross-reference(s): 76  
IT Electric insulators and Dielectrics  
(polyimide laminates for)  
IT 129197-24-6P 129197-26-8P 129219-40-5P 129219-42-7P  
(laminates, transparent and dielec., prepn. of)

L35 ANSWER 6 OF 6 ZCA COPYRIGHT 2003 ACS  
117:50297 Flexible heat control device. Sasaki, Shigekuni; Matsura,  
Toru; Nishi, Shiro; Ando, Shinji (Nippon Denshin Denwa K. K.,  
Japan). Jpn. Kokai Tokkyo Koho JP 04047939 A2 19920218 Heisei, 5  
pp. (Japanese). CODEN: JKXXAF. APPLICATION: JP 1990-155068  
19900615.

GI



AB The title device useful in satellites comprises a solar light reflection layer and resin-based heat radiation layer contg. polyimide of the structural unit I (R = org. group). A 50 .mu.m-thick 2,2-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride-2,2'-bis(trifluoromethyl)-4,4'-diaminobiphenyl copolymer film was coated 0.2 .mu.m thick with Ag by ion plating, then sputter-coated 0.1 .mu.m thick on the other side with Inconel for protection to give a flexible heat control device.

IT 129197-26-8

(silver-coated, flexible, for heat control devices, for satellites)

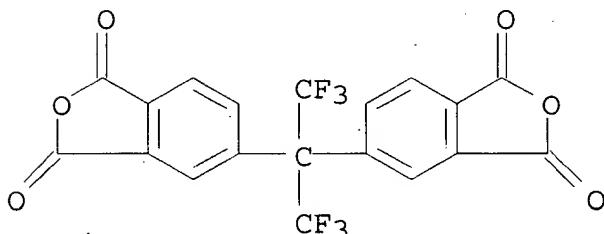
RN 129197-26-8 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

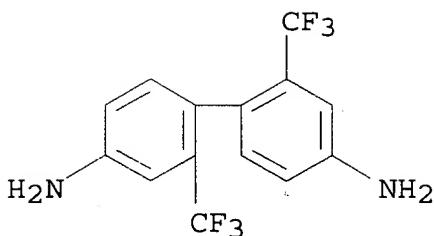
CMF C19 H6 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IC ICM B32B027-34  
 ICS B32B007-02; C08G073-10; C08L079-08  
 CC 38-3 (Plastics Fabrication and Uses)  
 ST satellite heat control device polyimide; fluorine contg polyimide  
 thermal insulator  
 IT Thermal insulators  
 (polyimide-based, flexible, for heat control devices, for  
 satellites)  
 IT 129197-26-8 129219-42-7 138454-62-3  
 (silver-coated, flexible, for heat control devices, for  
 satellites)

=> d 132 1-14 cbib abs hitstr hitrn

L32 ANSWER ① OF 14 ZCA COPYRIGHT 2003 ACS  
 136:93352 Synthesis and Characterization of Photosensitive Polyimides  
 for Optical Applications. Kim, Kye-Hyun; Jang, Seyoung; Harris,  
 Frank W. (Maurice Morton Institute and Department of Polymer Science  
 College of Polymer Science and Polymer Engineering, The University  
 of Akron, Akron, OH, 44325-3909, USA). Macromolecules, 34(26),  
 8925-8933 (English) 2001. CODEN: MAMOBX. ISSN: 0024-9297.  
 Publisher: American Chemical Society.

AB The objective of this research was to prep. colorless photosensitive  
 polyimides for optical applications. In the first approach to these  
 materials two new photosensitive end-capping agents, i.e.,  
 6-(4-aminophenoxy)hexyl methacrylate and di[2-  
 (methacryloyloxyethyl)] 5-aminoisophthalate, for polyimides were  
 prep'd. These agents were used along with 2,2-bis(3,4-  
 dicarboxyphenyl)hexafluoropropane dianhydride (6FDA) and  
 2,2'-bis(trifluoromethyl)-4,4'-diaminobiphenyl to prep. a series of  
 methacrylate end-capped imide oligomers. However, the oligomers  
 required long exposures to UV radiation to affect cure. To improve  
 their photosensitivity, multifunctional additives and  
 photoinitiators were used. A tetrafunctional end-capped oligomer  
 that contained 10 wt % trimethylolpropane triacrylate and 5 wt %  
 trimethylbenzoyldiphenyl phosphine oxide (TMDPO) was photosensitive  
 and displayed good photopatterning properties. A second approach to  
 the desired materials involved the synthesis of a diamine monomer,  
 i.e., 2,2'-dimethacryloyloxy-4,4'-diaminobiphenyl, in which  
 methacrylate moieties were attached to the 2- and 2'-positions of a

biphenyl structure. The monomer was polymd. with com. available dianhydrides such as 6FDA and 4,4'-oxydiphthalic anhydride. The polyimides obtained were sol. in common org. solvents such as THF, acetone, and chloroform and could be soln. cast into thin, water-white films that were highly transparent in the visible light region. The polymers were photosensitive when combined with 5 wt % TMDPO and displayed good photopatterning properties. The polymers, which afforded line patterns 10-30 .mu.m wide and 5-20 .mu.m thick, did not develop color or shrink during UV exposure and subsequent thermal treatments.

IT 143154-89-6DP, reaction products with methacrylate-contg. end-capping agents

(prep. and photoimaging properties of colorless polyimide photoresists contg. photosensitive end-capping groups)

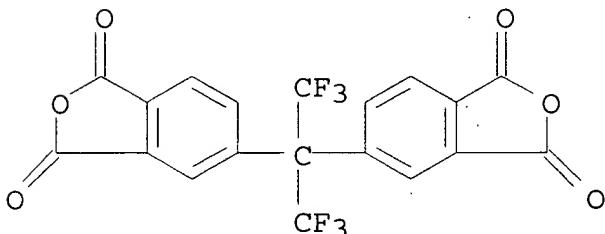
RN 143154-89-6 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

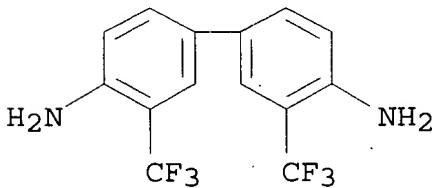
CMF C19 H6 F6 O6



CM 2

CRN 346-88-3

CMF C14 H10 F6 N2



IT 143154-89-6DP, reaction products with methacrylate-contg. end-capping agents

(prep. and photoimaging properties of colorless polyimide

photoresists contg. photosensitive end-capping groups)

L32 ANSWER 2 OF 14 ZCA COPYRIGHT 2003 ACS

133:121454 Polyimides with superior dielectric constants as  
 microelectronic coatings. Harris, Frank W.; Cheng, Stephen Z. D.  
 (University of Akron, USA). PCT Int. Appl. WO 2000045435 A1  
20000803, 54 pp. DESIGNATED STATES: W: AL, AM, AT, AU, AZ, BA, BB,  
 BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH,  
 GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS,  
 LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE,  
 SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, AM, AZ,  
 BY, KG, KZ, MD, RU, TJ, TM; RW: AT, BE, BF, BJ, CF, CG, CH, CI, CM,  
 CY, DE, DK, ES, FI, FR, GA, GB, GR, IE, IT, LU, MC, ML, MR, NE, NL,  
 PT, SE, SN, TD, TG. (English). CODEN: PIXXD2. APPLICATION: WO  
2000-US2281 20000128. PRIORITY: US 1999-PV117960 19990129.

AB The present invention provides an integrated circuit comprising an insulating layer comprising a polymer of 2,2'-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride (6FDA) or 4,4'-diamino-2,2'-bis(trifluoromethyl)biphenyl (PFMB) with fluorine substituent-contg. 4,4'-diamino-2,2'-disubstitutedbiphenyls and 2,2'-disubstituted-4,4'5,5'-biphenyltetracarboxylic dianhydrides, resp., possessing low dielec. consts., high coeffs. of thermal expansion, excellent thermal stability and excellent solv. in conventional org. solvents. Thus, copolymn. of 6FDA and 4,4'-diamino-2,2'-di(trifluoromethyl)biphenyl gives rise to a polyimide film having a dielec. const. of 2.38, a coeff. of thermal expansion of  $42.4 \times 10^{-6}/\text{degree.}$ , a glass transition temp. of 315 .degree. (TMA) and 342 .degree. (DSC), a 2% and 5% wt. loss in air and N<sub>2</sub> of 490/518 .degree. and 505/530 .degree. resp., and sol. in acetone, cyclopentanone, THF, N,N-Dimethylacetamide, DMF and N-Methylpyrrolidone.

IT 165323-80-8 217459-22-8 217459-25-1

217459-28-4 217459-31-9 217459-34-2

217459-37-5 217459-40-0 217459-43-3

(polyimides with superior dielec. consts. as microelectronic coatings)

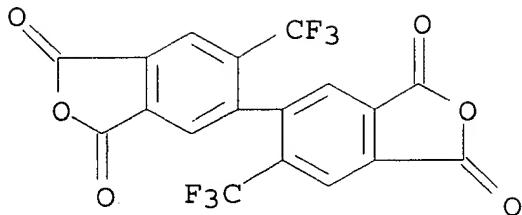
RN 165323-80-8 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 165323-75-1

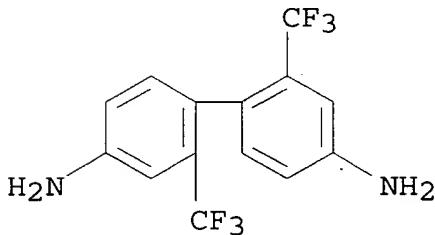
CMF C18 H4 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



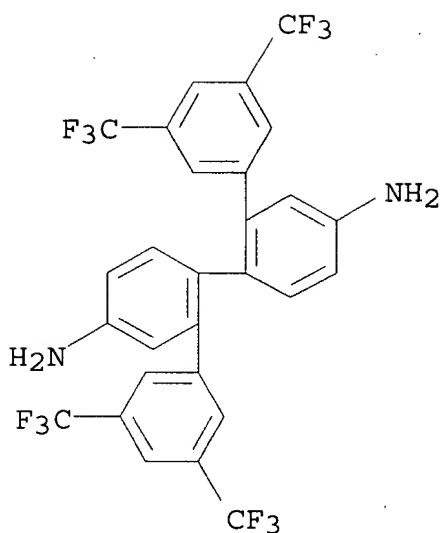
RN 217459-22-8 ZCA

CN 1,3-Isobenzofuranone, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'',5,5'''-tetrakis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

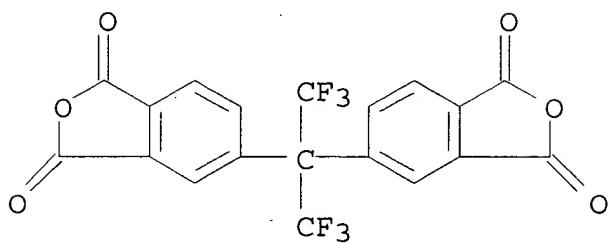
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CRN 217459-21-7

CMF C28 H16 F12 N2

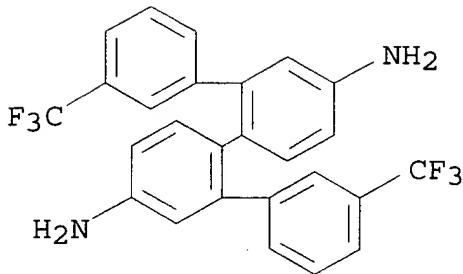


CM 2

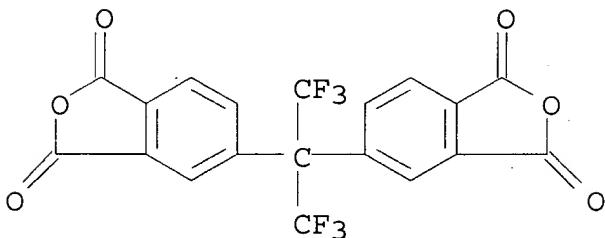
CRN 1107-00-2  
CMF C19 H6 F6 O6RN 217459-25-1 ZCA  
CN 1,3-Isobenzofuranone, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3''-bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-24-0  
CMF C26 H18 F6 N2

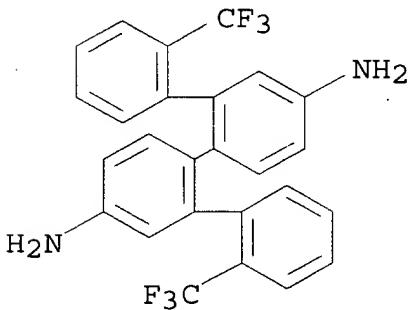


CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6

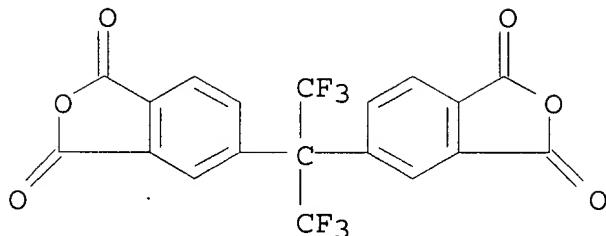
RN 217459-28-4 ZCA  
 CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'''-bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-27-3  
CMF C26 H18 F6 N2

CM 2

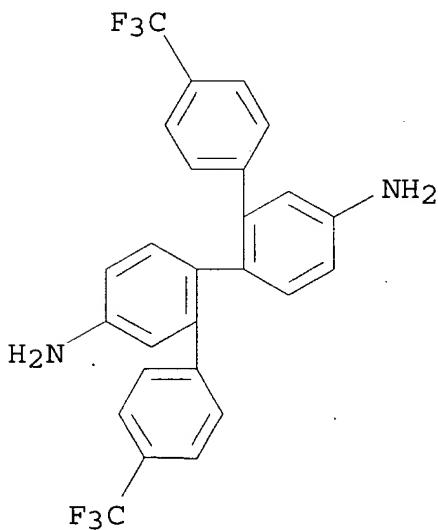
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 CMF C19 H6 F6 O6



RN 217459-31-9 ZCA  
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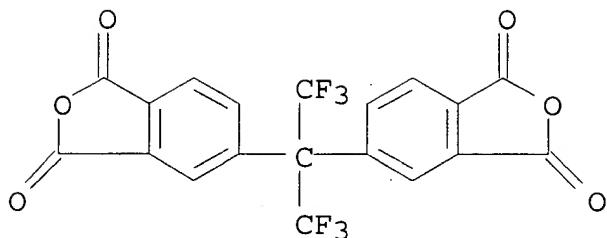
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CRN 217459-30-8  
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CM 2

CRN 1107-00-2  
 CMF C19 H6 F6 O6



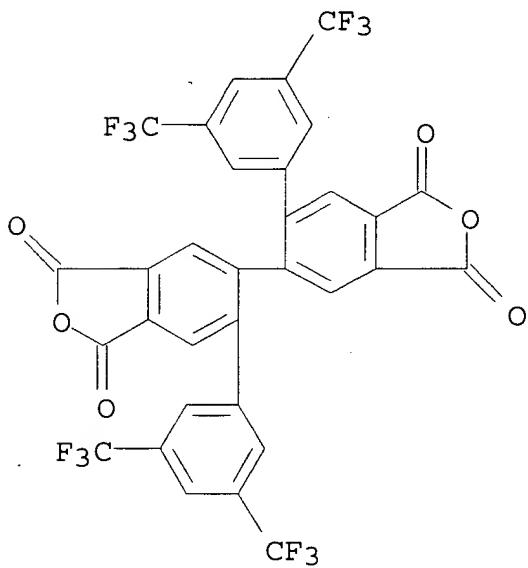
RN 217459-34-2 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[3,5-bis(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-33-1

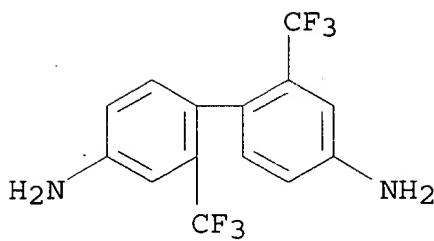
CMF C32 H10 F12 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



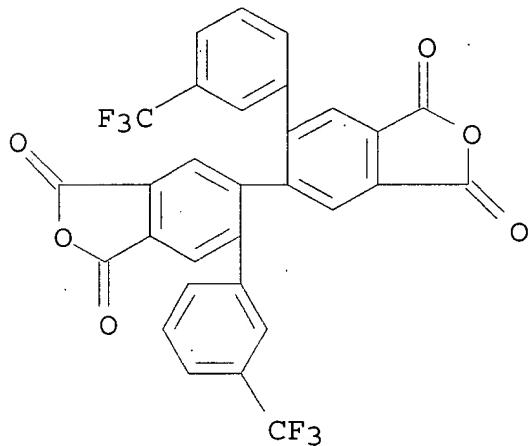
RN 217459-37-5 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[3-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-36-4

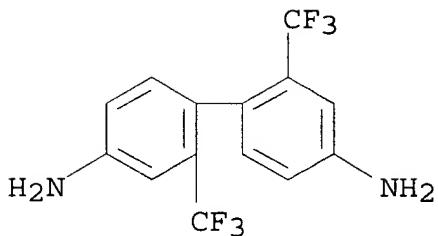
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



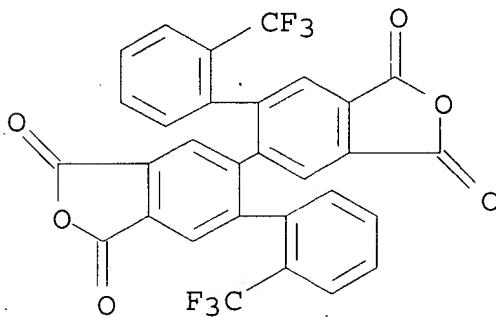
RN 217459-40-0 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[2-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-39-7

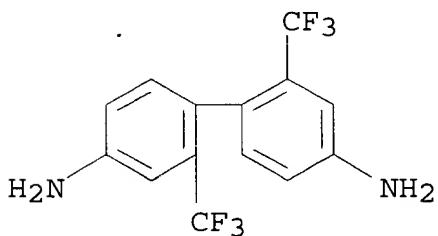
CMF C<sub>30</sub> H<sub>12</sub> F<sub>6</sub> O<sub>6</sub>



CM 2

CRN 341-58-2

CMF C<sub>14</sub> H<sub>10</sub> F<sub>6</sub> N<sub>2</sub>



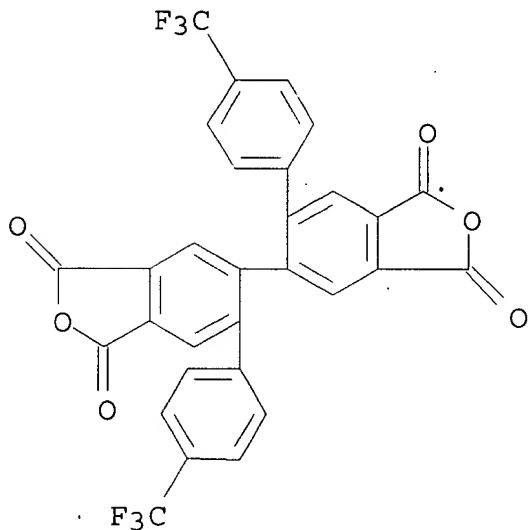
RN 217459-43-3 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[4-

(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

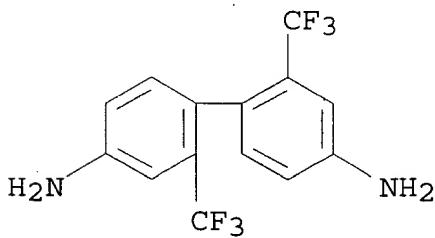
CM 1

CRN 217459-42-2  
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2  
CMF C14 H10 F6 N2



IT 165323-80-8 217459-22-8 217459-25-1  
217459-28-4 217459-31-9 217459-34-2  
217459-37-5 217459-40-0 217459-43-3

(polyimides with superior dielec. consts. as microelectronic coatings)

L32 ANSWER ③ OF 14 ZCA COPYRIGHT 2003 ACS  
132:86610 Formation of dielectric films with low dielectric constant and

their interlayer dielectric films and semiconductor devices.  
 Iijima, Masayuki; Sato, Masatoshi; Ukishima, Sadashi; Takahashi,  
 Yoshikazu (ULVC Japan, Ltd., Japan). Jpn. Kokai Tokkyo Koho JP  
 2000003910 A2 20000107, 7 pp. (Japanese). CODEN: JKXXAF.

APPLICATION: JP 1998-167628 19980616.

**AB** The process involves evapg. diamine monomers and acid monomers in vacuo and vapor-deposition polymn. on substrates to form polyimide films, wherein above monomers are free of oxygen atom besides those incorporated into imide rings. The diamine monomers may be selected from 4,4'-diaminodiphenylmethane, 4,4'-bis(4-aminophenoxy)biphenyl, 1,4-bis(4-aminophenoxy)benzene, 2,2-bis[4-(4-aminophenoxy)phenyl]hexafluoropropane, 2,2-bis[4-(4-aminophenoxy)phenyl]propane, 3,3'-dimethyl-4,4'-diaminobiphenyl, 3,3'-bis(trifluoromethyl)-4,4'-diaminobiphenyl, 3,3'-dimethoxy-4,4'-diaminobiphenyl, and 3,3'-bis(trifluoromethyl)-4,4'-diaminobiphenyl, and the acid monomers may be selected from pyromellitic dianhydride, 2,2'-bis(3,4-phenylcarboxyl)hexafluoropropane dianhydride, 4,4'-biphthalic acid dianhydride, and naphthalene-1,4,5,8-tetracarboxylic dianhydride. The interlayer dielec. films thus prep'd. are formed between metal wiring layers and substrates, wherein the wiring layers and the dielec. films are in direct contact with each other. The polyimide films contains less oxygen in the mols, thereby preventing Cu in wires from being oxidized.

**IT** 143154-89-6P

(formation of dielec. films by vapor-deposition polymn. for semiconductor device interlayers)

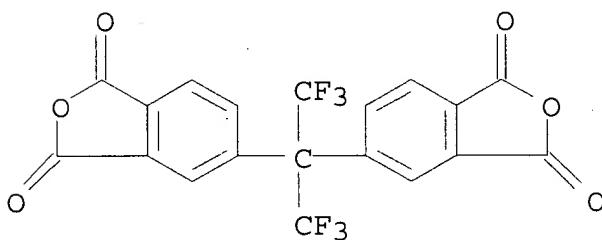
**RN** 143154-89-6 ZCA

**CN** 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

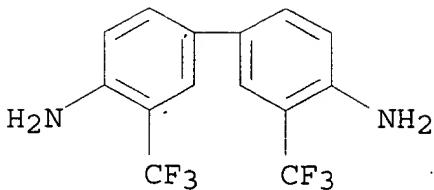
CMF C19 H6 F6 O6



CM 2

CRN 346-88-3

CMF C14 H10 F6 N2



IT 143154-89-6P

(formation of dielec. films by vapor-deposition polymn. for semiconductor device interlayers)

L32 ANSWER 4 OF 14 ZCA COPYRIGHT 2003 ACS

131:145196 Dianhydride architectural effects on the relaxation behaviors and thermal and optical properties of organo-soluble aromatic polyimide films. Li, Fuming; Ge, Jason J.; Honigfort, Paul S.; Fang, Shane; Chen, Jyh-Chien; Harris, Frank W.; Cheng, Stephen Z. D. (Maurice Morton Institute and Department of Polymer Science, The University of Akron, Akron, OH, 44325-3909, USA). Polymer, 40(18), 4987-5002 (English) 1999. CODEN: POLMAG. ISSN: 0032-3861.

Publisher: Elsevier Science Ltd..

AB Dianhydrides of specific mol. architecture was designed and synthesized based on 2,2'-disubstituted 4,4',5,5'-biphenyltetracarboxylic dianhydrides (2,2'-disubstituted BPDA's). Eight dianhydrides were polymd. with two 4,4'-diamino-2,2'-disubstituted biphenyl diamines (trifluoromethyl disubstituted groups, or PFMB, and Me disubstituted groups, or DMB) to obtain two series of PFMB- and DMB-based arom. polyimides. As the backbone structures of these two series of polyimides are unchanged throughout each series, the effects of the 2,2'-disubstituted groups of both the dianhydride and diamine constituents on the solv. and thermal and optical properties as well as the relaxation behavior of these polyimides can be identified. It was found that the PFMB-based polyimides with 2,2'-disubstituted BPDA's show excellent solv. while the DMB-based polyimides with the same dianhydrides are less sol. The same trends can be found for both thermal and thermo-oxidative stability and optical transparency in the UV and visible light regions. These two series of polyimides exhibit glass transition temps. (Tg) which show a competition between chain rigidity and linearity with regards to mol. packing. When the size of the 2,2'-disubstituted groups is small and their shape is close to spherical, the Tg initially increases with the size of these 2,2'-disubstituted groups. This is because of the fact that the steric hindrance of these groups prevents the appearance of a cis-conformation of BPDA. However, once these groups possess large size and exhibit anisotropic shapes, their effect on the mol. packing becomes dominant and the Tg starts to decrease. Further, this is the first time that three relaxation processes (the .beta.1, .beta.2, and .alpha. processes) were obsd. above room temp. in these arom. polyimides. We have identified that the .beta.1 process is attributed to the local motion of the diamine constituents while the

.beta.2 process is caused by the local motion of the dianhydride constituents. The .alpha. process is assocd. with the glass transition. The cooperativity of the mol. motion assocd. with the .beta.1 and .beta.2 processes are also discussed.

IT 165323-80-8P 217459-34-2P 217459-37-5P  
217459-40-0P 217459-43-3P

(dianhydride architectural effects on the relaxation behavior, thermal stability, and optical properties of organo-sol. arom. polyimide films)

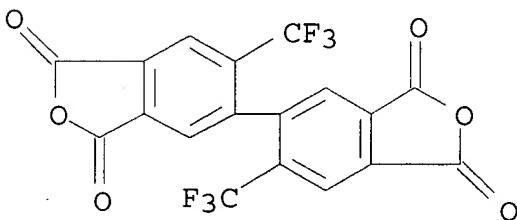
RN 165323-80-8 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 165323-75-1

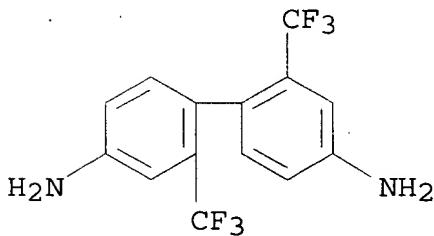
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CM 2

CRN 341-58-2

CMF C14 H10 F6 N2

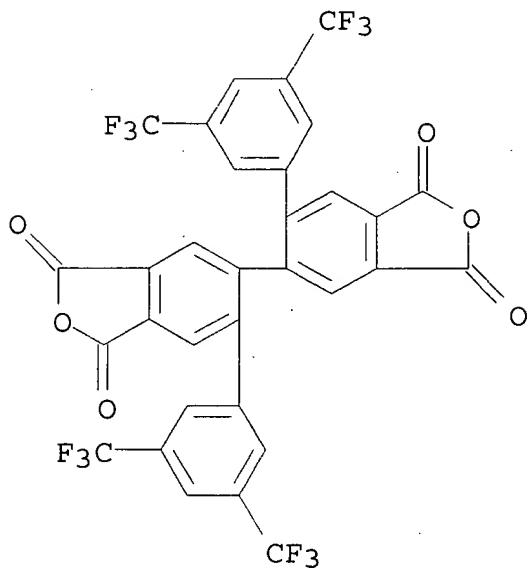


RN 217459-34-2 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[3,5-bis(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

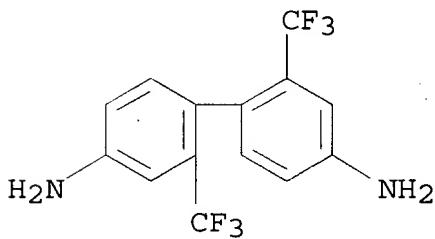
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CM 2

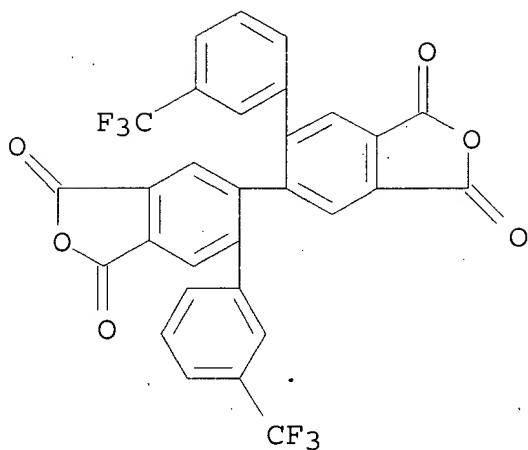
CRN 341-58-2  
 CMF C14 H10 F6 N2



RN 217459-37-5 ZCA  
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CM 1

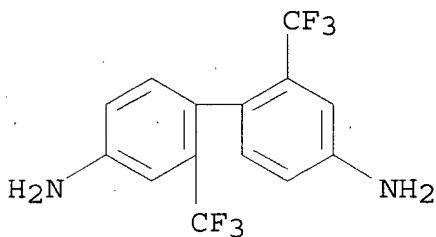
CRN 217459-36-4  
 CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



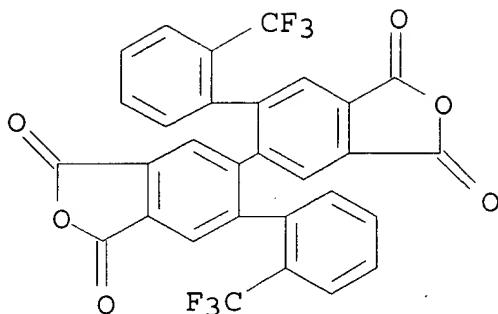
RN 217459-40-0 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[2-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-39-7

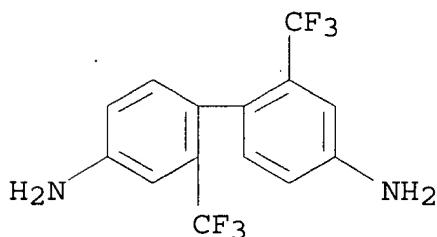
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



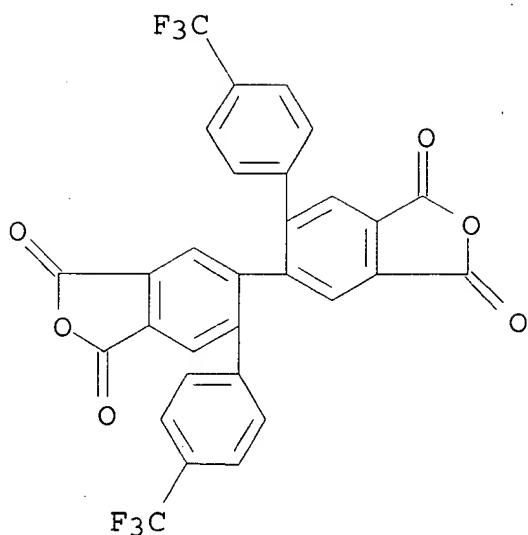
RN 217459-43-3 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[4-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

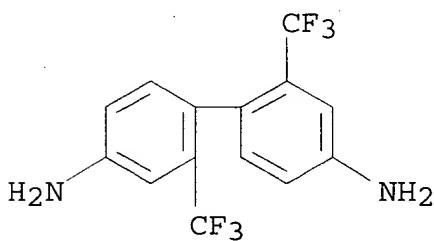
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CMF C30 H12 F6 O6



CM 2

CRN . 341-58-2  
CMF C14 H10 F6 N2



IT 165323-80-8P 217459-34-2P 217459-37-5P  
217459-40-0P 217459-43-3P

(dianhydride architectural effects on the relaxation behavior, thermal stability, and optical properties of organo-sol. arom. polyimide films)

L32 ANSWER (5) OF 14 ZCA COPYRIGHT 2003 ACS

131:88546 Diamine architecture effects on glass transitions, relaxation processes and other material properties in organo-soluble aromatic polyimide films. Li, F.; Fang, S.; Ge, J. J.; Honigfort, P. S.; Chen, J.-C.; Harris, F. W.; Cheng, S. Z. D. (Maurice Morton Institute and Department of Polymer Science, The University of Akron, Akron, OH, 44325-3909, USA). *Polymer*, 40(16), 4571-4583 (English) 1999. CODEN: POLMAG. ISSN: 0032-3861. Publisher: Elsevier Science Ltd..

AB A series of twelve arom. diamines, 4,4'-diamino-2,2'-

disubstituted biphenyls, has been designed and synthesized. These diamines were reacted with 2,2'-bis(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA) to form polyimides via a one-step polycondensation method. All of the resulting polyimides could be dissolved in common org. solvents and exhibited excellent film forming ability. At the same time, their inherent high thermal and thermo-oxidative stability of these polyimides was retained in the films. Because of the incorporation of disubstituted groups at the 2- and 2'-positions of these biphenyl diamines, their crystallinity was suppressed to the level that they were in complete amorphous state. Further, the conjugation of the phenylene and imide groups in these polyimide films was interrupted, leading to clear blue shifts during light transmission. As this series of polyimides possessed the same backbone, the chain rigidity and linearity changed very little throughout the series. However, the mol. packing was affected by the introduction of different disubstituted pendant groups. Each polyimide film exhibited an .alpha. relaxation process related to the glass transition. This relaxation changed significantly with the size and the shape of the disubstituted pendant groups. In addn. to this process, each of these polyimide films displayed a sub-glass transition, the .beta. relaxation process, which was initiated by motion of the 4,4'-diamino-2-2'-disubstituted biphenyls. This study provided an opportunity to investigate how disubstituted pendant groups affected the .alpha. and .beta. relaxation behaviors of these polyimides. With an increase of the sizes and the shape anisotropy of the disubstituted pendant groups at the 2- and 2'-position, the nature of the motion regarding to the .beta. relaxation was found to evolve from a non-cooperative process to a cooperative one, while the glass transition temp. (the .alpha. relaxation temp.) correspondingly decreased.

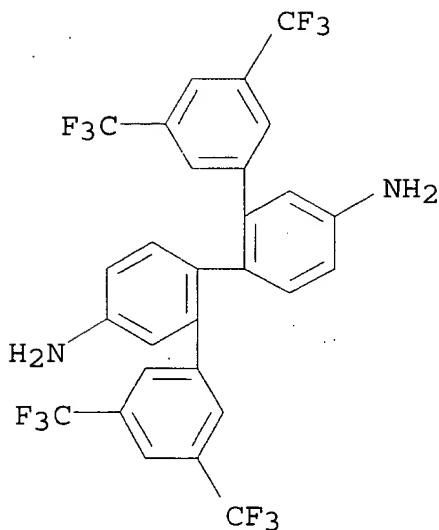
IT 217459-22-8P 217459-25-1P 217459-28-4P  
217459-31-9P

(effect of diamine structure on glass transitions, relaxation processes and other material properties in organo-sol. arom. polyimide films)

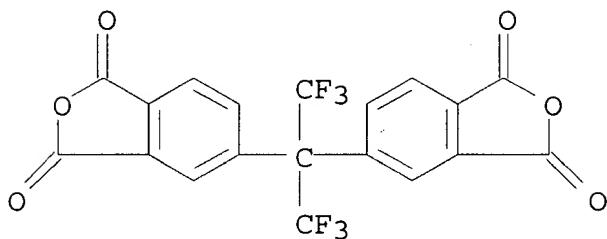
RN 217459-22-8 ZCA  
CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'',5,5'''-tetrakis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-21-7  
CMF C28 H16 F12 N2



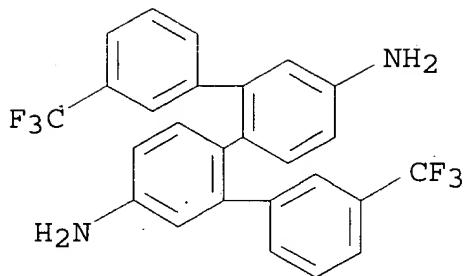
CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6

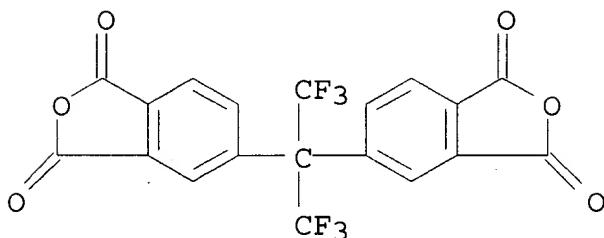
RN 217459-25-1 ZCA  
 CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'''-bis(trifluoromethyl)[1,1':2',1'':2'',1''':4''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-24-0  
CMF C26 H18 F6 N2

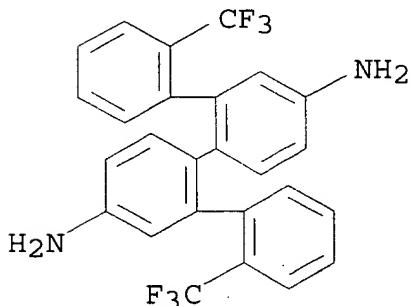


CM 2

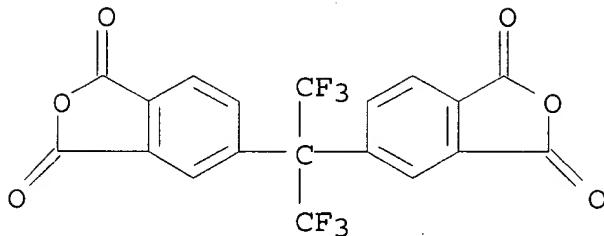
CRN 1107-00-2  
CMF C19 H6 F6 O6

RN 217459-28-4 ZCA  
 CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2'--bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

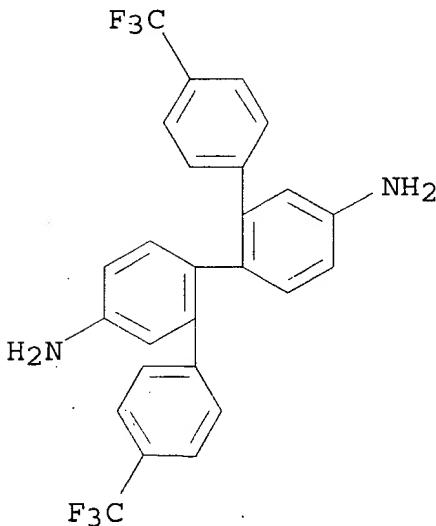
CRN 217459-27-3  
CMF C26 H18 F6 N2

CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6

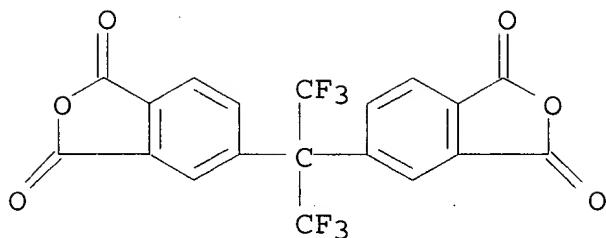
RN 217459-31-9 ZCA  
 CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 4,4'''-bis(trifluoromethyl)[1,1':2',1''':2'',1'''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-30-8  
CMF C26 H18 F6 N2

CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6



IT 217459-22-8P 217459-25-1P 217459-28-4P  
217459-31-9P

(effect of diamine structure on glass transitions, relaxation processes and other material properties in organo-sol. arom. polyimide films)

L32 ANSWER 6 OF 14 ZCA COPYRIGHT 2003 ACS

131:32404 Laser light-scattering studies of soluble high performance fluorine-containing polyimides. Kwan, Simon Chi Man; Wu, Chi; Li, Fuming; Harris, Frank W.; Cheng, Stephen Z. D. (Department of Chemistry, The Chinese University of Hong Kong, Shatin, Hong Kong). Polymer Engineering and Science, 39(3), 586-593 (English) 1999.

CODEN: PYESAZ. ISSN: 0032-3888. Publisher: Society of Plastics Engineers.

AB Two sets of sol. high performance polyimides synthesized from 2,2'-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride (6FDA) and 2,2'-(trifluoromethyl)-4,4'-diaminobiphenyl diamine (PFMB), and from 2,2'-bis(trifluoromethyl)-4,4',5,5'-biphenyl-tetracarboxylic dianhydride (HFBPDA) and 2,2'-(trifluoromethyl)-4,4'-diaminobiphenyl diamine (PFMB) have been investigated by static and dynamic laser light scattering (LLS) in THF (THF) at 30.degree.C. The calibrations, for 6FDA-PFMB:  $\langle Rg \rangle$  (nm) = 3.87 .times. 10-2  $\langle M_w \rangle$  0.568,  $\langle Rh \rangle$  (nm) = 2.38 .times. 10-2  $\langle M_w \rangle$  0.560 and  $\langle D \rangle$  (cm<sup>2</sup>/s) = 2.13 .times. 10-4  $\langle M_w \rangle$  -0.560; for HFBPDA-PFMB:  $\langle Rg \rangle$  (nm) = 2.24 .times. 10-2  $\langle M_w \rangle$  0.626,  $\langle Rh \rangle$  (nm) = 1.27 .times. 10-2  $\langle M_w \rangle$  0.621 and  $\langle D \rangle$  (cm<sup>2</sup>/s) = 3.99 .times. 10-4  $\langle M_w \rangle$  -0.621, have been established, where  $\langle M_w \rangle$ ,  $\langle Rg \rangle$ ,  $\langle Rh \rangle$  and  $\langle D \rangle$  are the wt.-av. molar mass, the root mean square z-av. radius of gyration, the z-av. hydrodynamic radius and the z-av. translational diffusion coeff., resp. A combination of  $\langle M_w \rangle$  and the translational diffusion coeff. distribution G(D) leads to the calibrations of  $D$  (cm<sup>2</sup>/s) = 2.41 .times. 10-4M-0.564 and  $D$  (cm<sup>2</sup>/s) = 6.16 .times. 10-4M-0.656 for 6FDA-PFMB and HFBPDA-PFMB, resp., where D and M correspond to monodisperse species. With these calibrations, we can convert a translational diffusion coeff. distribution G(D) into a corresponding molar mass distribution fw(M). On the basis of the Kratky-Porod wormlike chain model, the persistence lengths (q) were found to be apprx. 3.3 nm and apprx. 4.5 nm, resp., for 6FDA-PFMB and HFBPDA-PFMB, which indicates that both polyimide chains have an extended conformation. In addn.,  $\langle Rg \rangle / \langle Rh \rangle$  apprx. (1.7-1.9) shows that they are in coil conformation. Therefore, we conclude that both polyimides have an

extended coil conformation.

IT 165323-80-8

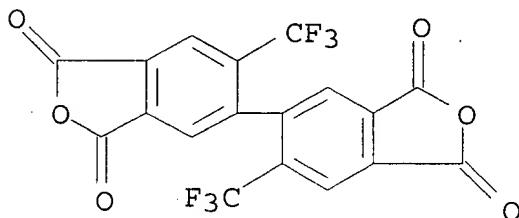
(laser light-scattering studies of sol. high performance fluorine-contg. polyimides)

RN 165323-80-8 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

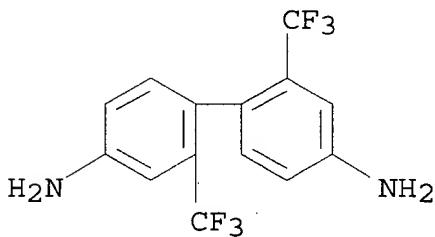
CM 1

CRN 165323-75-1  
CMF C18 H4 F6 O6



CM 2

CRN 341-58-2  
CMF C14 H10 F6 N2



IT 165323-80-8

(laser light-scattering studies of sol. high performance fluorine-contg. polyimides)

L32 ANSWER 7 OF 14 ZCA COPYRIGHT 2003 ACS

130:53010 Dielectric behavior and film surface structure in fluorinated aromatic polyimide films. Fang, S.; Chen, J.; Harris, F. W.; Cheng, S. Z. D.; Shuele, D. (University of Akron, OH, USA). Proceedings of the Conference of the North American Thermal Analysis Society, 26th Cleveland, Sept. 13-15, 1998, 357-362. Editor(s): Williams, Kathryn R. Omnipress: Madison, Wis. (English) 1998. CODEN: 66VEAV.

AB Two series of fluorinated arom. polyimides were developed as novel dielec. packing materials with potential applications in

microelectronics. These polyimides were synthesized based on diamines or dianhydrides contg. (trifluoromethyl)phenyl groups at the 2- and 2'-positions of biphenyl units. Powder samples displayed excellent solv. in common org. solvents, and film samples were tough, flexible, transparent and thermally stable with low permittivities, moderately low CTEs, and high Tgs. These polyimides exhibited multiple relaxations in dynamic mech. and dielec. anal. The optical birefringence and the dielec. relaxation anisotropy characterized the structural in-plane orientation within these amorphous polyimide films.

IT 217459-22-8 217459-25-1 217459-28-4

217459-31-9 217459-34-2 217459-37-5

$$217459 - 40 = 0 \quad 217459 - 43 = 3$$

(dielec. behavior and film surface structure in fluorinated arom. polyimide films as dielec. packing materials for microelectronics)

BN 217459-22-8 ZCA

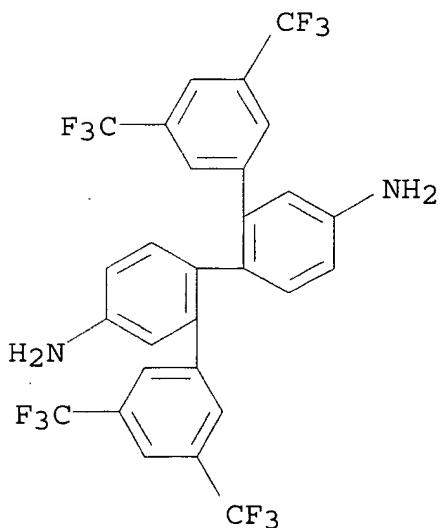
CN 1,3-Isobenzofurandione, 5,5'-(2,2,2-trifluoro-1-

1,3-isobenzofuranone, 3,3'-(2,2,2-trifluoro-1-(trifluoromethyl)ethylidene)bis-, polymer with 3,3'',5,5'''-tetrakis(trifluoromethyl)[1,1':2',1'':2'',1''''-quaterphenyl]-4'',5''-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-21-7

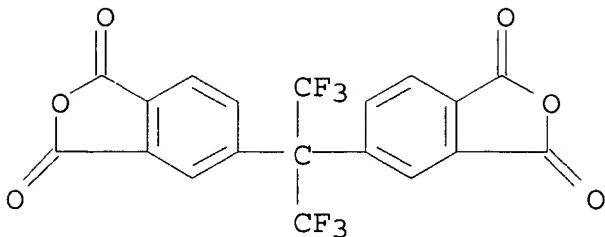
CME C28 H16 F12 N2



CM 2

CRN 1107-00-2

CMF C19 H6 F6 O6



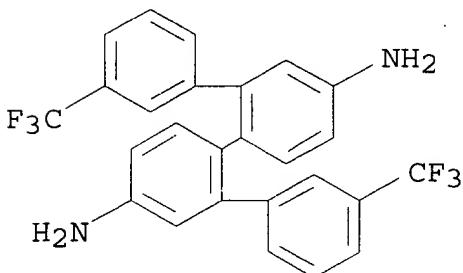
RN 217459-25-1 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3''-bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-24-0

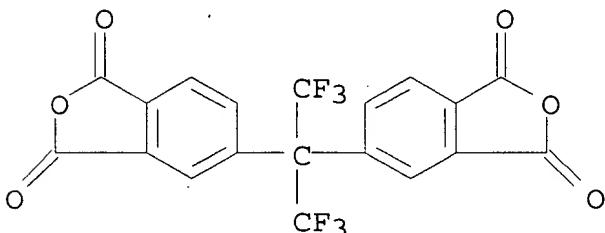
CMF C26 H18 F6 N2



CM 2

CRN 1107-00-2

CMF C19 H16 F6 O6



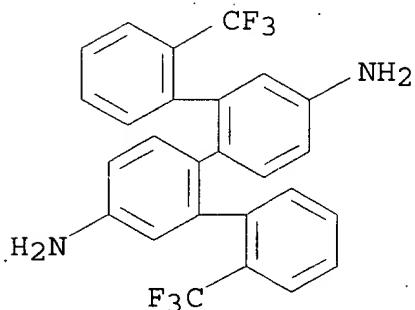
RN 217459-28-4 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 2,2''-bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5'-

diamine (9CI) (CA INDEX NAME)

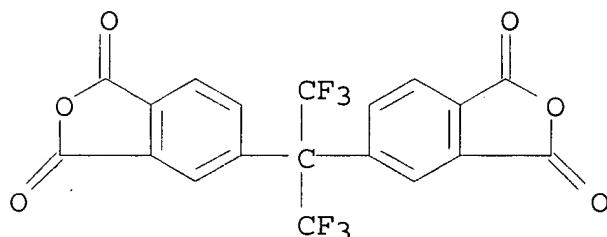
CM 1

CRN 217459-27-3  
CMF C26 H18 F6 N2



CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6

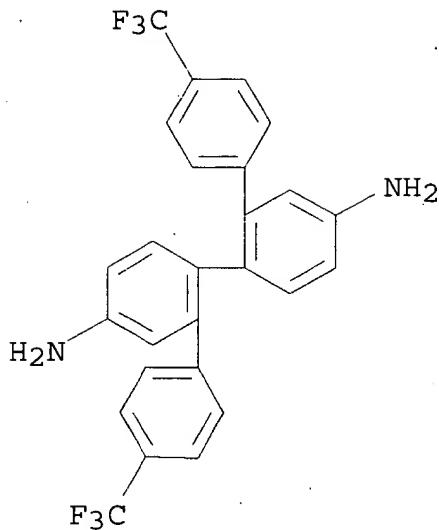


RN 217459-31-9 ZCA

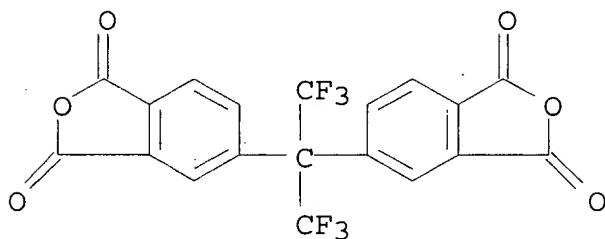
CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 4,4'''-bis(trifluoromethyl)[1,1':2',1'':2'',1'''-quaterphenyl]-4'',5'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-30-8  
CMF C26 H18 F6 N2



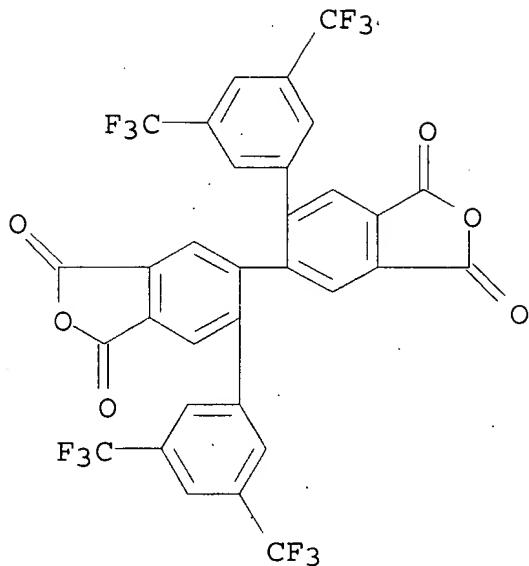
CM 2

CRN 1107-00-2  
CMF C19 H6 F6 O6

RN 217459-34-2 ZCA  
 CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[3,5-bis(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

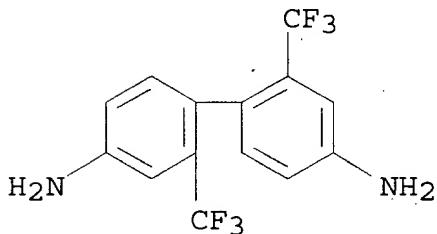
CRN 217459-33-1  
CMF C32 H10 F12 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



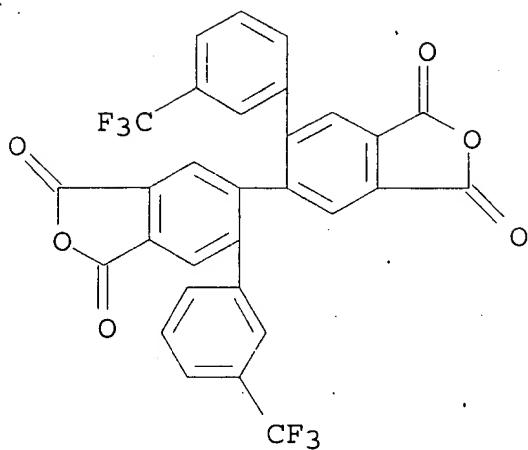
RN 217459-37-5 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[3-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-36-4

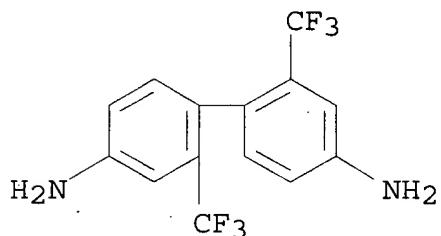
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



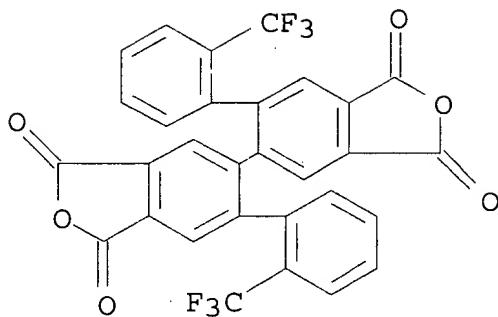
RN 217459-40-0 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[2-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-39-7

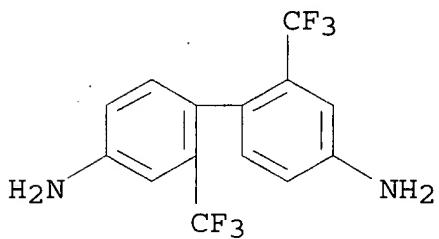
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



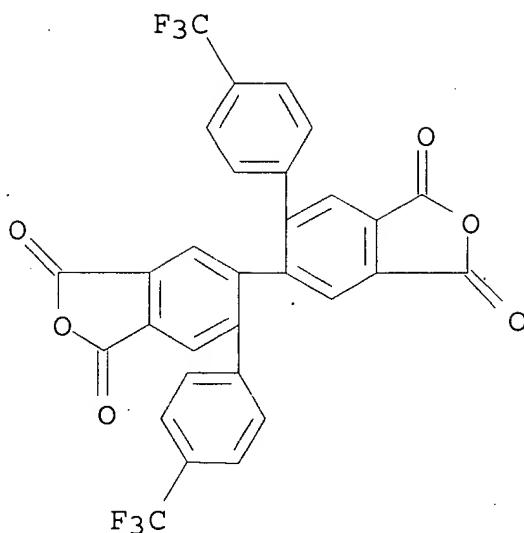
RN 217459-43-3 ZCA

CN [5,5'-Biisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis[4-(trifluoromethyl)phenyl]-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 217459-42-2

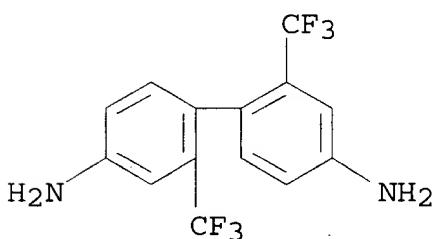
CMF C30 H12 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IT 217459-22-8 217459-25-1 217459-28-4

217459-31-9 217459-34-2 217459-37-5

217459-40-0 217459-43-3

(dielec. behavior and film surface structure in fluorinated arom. polyimide films as dielec. packing materials for microelectronics)

L32 ANSWER 8 OF 14 ZCA COPYRIGHT 2003 ACS

128:271103 Investigation of the solution behavior of organosoluble aromatic polyimides. Savitski, Edward P.; Li, Fuming; Lin, Sheng Hsien; McCreight, Kevin W.; Wu, William; Hsieh, Elaine; Rapold, Roland F.; Leland, Mark E.; McIntyre, Donald M.; Harris, Frank W.; Cheng, Stephen Z. D.; Kwan, Simon Chi Man; Wu, Chi (Maurice Morton Institute, University Akron, Akron, OH, 44325, USA). International Journal of Polymer Analysis and Characterization, 4 (2), 153-172 (English) 1997. CODEN: IPACEZ. ISSN: 1023-666X. Publisher: Gordon

& Breach Science Publishers.

AB Two high-mol.-wt. organosol. arom. polyimides having the same diamine, 2,2'-(trifluoromethyl)-4,4'-diaminobiphenyl diamine (PFMB), but different dianhydrides, 2,2'-bis(trifluoromethyl)-4,4',5,5'-biphenyltetracarboxylic dianhydride (HFBPDA) and 2,2'-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride (6FDA), were prep'd. via one-step polycondensation reactions. Mol. wt. fractionation of these two polymers was carried out and the polyimide fractions possess successively lower wt.-av. mol. wts. Intrinsic viscosity data from both sets of polyimide fractions gave the Mark-Houwink-Sakurada consts. of these two polyimides, which reflect differing chain rigidity in THF (THF) solns. The MHS relations are [.eta.] = 5.24 .times. 10-4 M0.65 and [.eta.] = 3.77 .times. 10-5 M0.97 for 6FDA-PFMB and HFBPDA-PFMB, resp. The phys. meanings of these consts. are discussed using the intrinsic viscosity data of these two polyimides in varying solvents. The persistence lengths are calcd. based on the viscosity and mol. wt. results using Bohdanecky's approach and they were calcd. to be 6.6 and 2.0 nm for HFBPDA-PFMB and 6FDA-PFMB, resp. The exptl. results indicate that the fully arom. HFBPDA-PFMB is more rigid in THF solns. compared with 6FDA-PFMB. However, both of these polyimides are far from possessing true rigid-rod character. Plots of the wt.-av. mol. wt. against the elution vol. depict the differences in chain stiffness, and hence in hydrodynamic vol., between samples. Examn. of the hydrodynamic vol. of these polymers provides evidence that they both subscribe rather well to hydrodynamic theory at high mol. wts. but that the stiffer HFBPDA-PFMB shows deviation at lower values.

IT 165323-80-8P

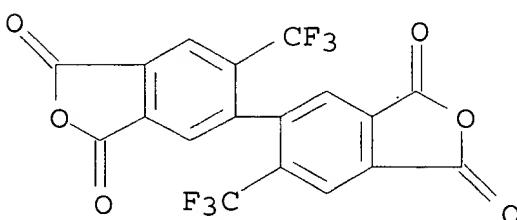
(prepn. and soln. behavior of organosol. arom. polyimides)

RN 165323-80-8 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

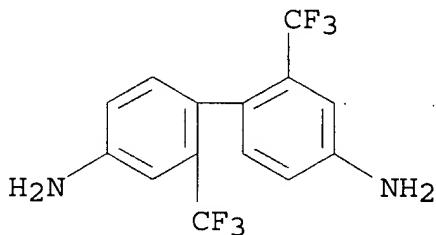
CM 1

CRN 165323-75-1  
CMF C18 H4 F6 O6



CM 2

CRN 341-58-2  
CMF C14 H10 F6 N2



IT 165323-80-8P  
(prepn. and soln. behavior of organosol. arom. polyimides)

L32 ANSWER 6 OF 14 ZCA COPYRIGHT 2003 ACS  
128:205186 Organo-Soluble Polyimides: Synthesis and Polymerization of 2,2'-Bis(trifluoromethyl)-4,4',5,5'-Biphenyltetracarboxylic Dianhydride. Lin, Sheng-Hsien; Li, Fuming; Cheng, Stephen Z. D.; Harris, Frank W. (Maurice Morton Institute and the Department of Polymer Science, University of Akron, Akron, OH, 44325-3909, USA). Macromolecules, 31(7), 2080-2086 (English) 1998. CODEN: MAMOBX.  
ISSN: 0024-9297. Publisher: American Chemical Society.

AB 2,2'-Bis(trifluoromethyl)-4,4',5,5'-biphenyltetracarboxylic dianhydride (6FBPDA) was synthesized from 1-iodo-4,5-dimethyl-2-nitrobenzene via a six-step synthetic route. The dianhydride was polymd. with eight different substituted 4,4'-diaminobiphenyls in refluxing m-cresol contg. isoquinoline to afford a series of fluorinated arom. polyimides. The polyimides were sol. in polar aprotic, ether and ketone solvents. They had intrinsic viscosities 1.70-6.72 dL/g in N-methyl-2-pyrrolidinone or m-cresol at 30.degree.. The polymers underwent 5% wt. losses when subjected to thermal gravimetric anal. between 440° and 570.degree. in air and nitrogen atmospheres. The polymers could be soln. cast into water-white, flexible, tough films which exhibited "in-plane" structural anisotropy. Their glass transition temps. along the directions parallel to the film surface (in-plane) ranged from 327 to 345.degree. (thermal mech. anal.). Multiple relaxation processes assocd. with segmental and subsegmental motions were also obsd. with dynamic mech. anal. The films had in-plane coeffs. of thermal expansion (1.58-2.50) .times. 10<sup>-5</sup> .degree.C<sup>-1</sup>. These films also showed linear optical anisotropy, which is characterized by the presence of larger, isotropic refractive index (n dblvert.) in-plane, and a smaller refractive index (n perp.) perpendicular to the film surface (out-of-plane). The optical symmetry axis of the films is along the out-of-plane direction. This optical anisotropy is defined as uniaxial neg. birefringence (NUB = n perp. - n dblvert.). Films having a thickness of 5 .mu.m were transparent above 330 nm, and their in-plane refractive indexes (n dblvert.) were 0.060 to 0.074 larger than their out-of-plane refractive indexes (n perp.). This UNB make the films candidates for use as

IT retardation layers in liq. crystal displays.

**165323-80-8P**

(synthesis, mech., thermal, rheol., and solv. of fluoro arom. polyimides from 2,2'-bis(trifluoromethyl)-4,4',5,5'-biphenyltetra carboxylic dianhydride and diamines)

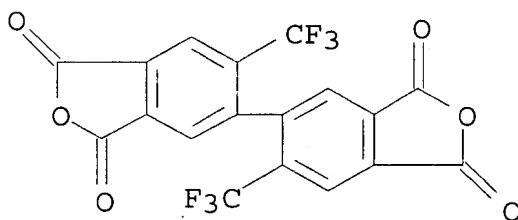
RN 165323-80-8 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 165323-75-1

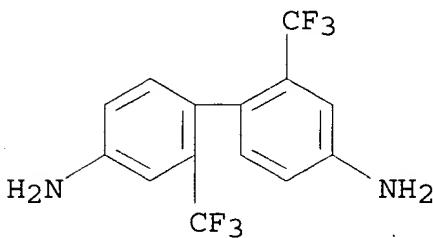
CMF C18 H4 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IT **165323-80-8P**

(synthesis, mech., thermal, rheol., and solv. of fluoro arom. polyimides from 2,2'-bis(trifluoromethyl)-4,4',5,5'-biphenyltetra carboxylic dianhydride and diamines)

L32 ANSWER 10 OF 14 ZCA COPYRIGHT 2003 ACS

124:119737 Negative birefringent polyimide films. Harris, Frank W.; Cheng, Stephen Z. D. (The University of Akron, USA). U.S. US 5480964 A 19960102, 47 pp. Cont.-in-part of U.S. 5,344,916.

(English). CODEN: USXXAM. APPLICATION: US 1994-230729 19940421.

PRIORITY: US 1993-51068 19930421; US 1993-72137 19930604.

AB A neg. birefringent film, useful as compensator layer in liq.

crystal displays, and a method for controlling the neg. birefringence of a polyimide film is disclosed which allows the matching of an application to a targeted amt. of birefringence by controlling the degree of in-plane orientation of the polyimide by the selection of functional groups within both the diamine and dianhydride segments of the polyimide which affect the polyimide backbone chain rigidity, linearity, and symmetry. The higher the rigidity, linearity and symmetry of the polyimide backbone, the larger the value of the neg. birefringence of the polyimide film.

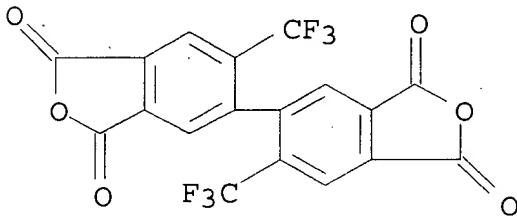
IT 165323-80-8P  
 (neg. birefringent polyimide films as compensator layers in liq. crystal displays)

RN 165323-80-8 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl) [1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

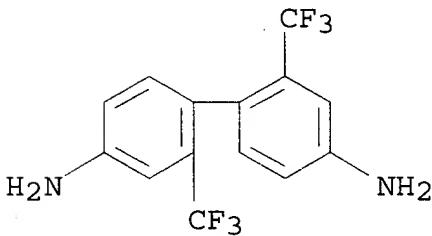
CM 1

CRN 165323-75-1  
 CMF C18 H4 F6 O6



CM 2

CRN 341-58-2  
 CMF C14 H10 F6 N2



IT 165323-80-8P  
 (neg. birefringent polyimide films as compensator layers in liq. crystal displays)

123:84363 organo-soluble polyimides from substituted dianhydrides.

Harris, Frank W.; Lin, Sheng Hsin (University of Akron, USA). U.S.  
US 5395918 A 19950307, 15 pp. (English). CODEN: USXXAM.

APPLICATION: US 1994-230636 19940421.

AB Polyimides are synthesized from biphenyl dianhydrides substituted, particularly at the 2 and 2' positions on the Ph rings, and exhibit enhanced solv. A polyimide was prep'd. from 2,2'-bis(trifluoromethyl)-4,4'-diaminobiphenyl and 2,2'-dibromo-4,4',5,5'-biphenyltetracarboxylic dianhydride.

IT 165323-80-8P

(organo-sol. polyimides from substituted dianhydrides)

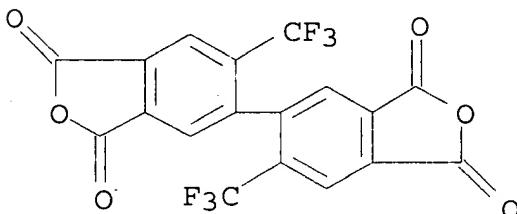
RN 165323-80-8 ZCA

CN [5,5'-Bisobenzofuran]-1,1',3,3'-tetrone, 6,6'-bis(trifluoromethyl)-, polymer with 2,2'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 165323-75-1

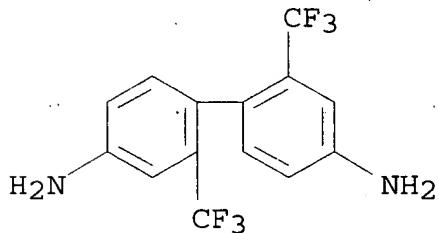
CMF C18 H4 F6 O6



CM 2

CRN 341-58-2

CMF C14 H10 F6 N2



IT 165323-80-8P

(organo-sol. polyimides from substituted dianhydrides)

L32 ANSWER ② OF 14 ZCA COPYRIGHT 2003 ACS

121:206482 Polarization Effects of Fluorine on the Relative Permittivity in Polyimides. Hougham, G.; Tesoro, G.; Viehbeck, A.;

Chapple-Sokol, J. D. (T. J. Watson Research Center, IBM, Yorktown Heights, NY, 10598, USA). *Macromolecules*, 27(21), 5964-71 (English) 1994. CODEN: MAMOBX. ISSN: 0024-9297.

AB The effect of F incorporation on dielec. properties has been studied for a series of polyimides to distinguish between several contributing mechanisms to the generally obsd. decrease in the relative permittivity. Using low-frequency capacitance measurements after exhaustive in situ drying, in conjunction with refractive index measurements, the overall decrease in dielec. const., obsd. upon F substitution, was semiquant. assigned between changes in 3 modes of polarization via the use of F/H and sym./unsym. analogs. These results suggest that replacement of H with F always lowers the dielec.-const. increment due to the electronic mode of polarization, has little effect on the at. increment, and, in the case of asym. F substitution, increases the orientation increment. Values for each of these effects are reported.

IT 143154-89-6

(dielec. properties of)

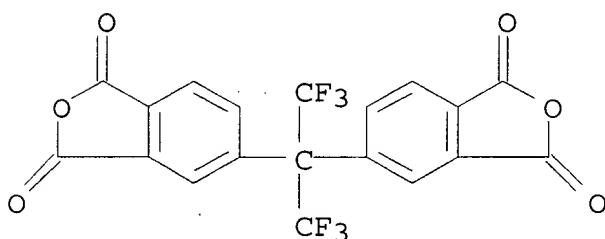
RN 143154-89-6 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

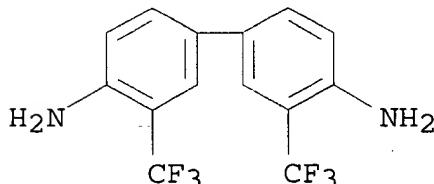
CMF C19 H6 F6 O6



CM 2

CRN 346-88-3

CMF C14 H10 F6 N2



IT 143154-89-6

(dielec. properties of)

L32 ANSWER 13 OF 14 ZCA COPYRIGHT 2003 ACS

121:36329 Synthesis and Properties of Highly Fluorinated Polyimides.  
 Hougham, G.; Tesoro, G.; Shaw, J. (T. J. Watson Research Center, IBM, Yorktown Heights, NY, 10598, USA). Macromolecules, 27(13), 3642-9 (English) 1994. CODEN: MAMOBX. ISSN: 0024-9297.

AB A series of polyimides was synthesized to facilitate the study of several structure/property relationships, including relative permittivity, moisture absorption, free vol., and viscoelastic transitions. This series was based on hexafluoroisopropylidenebis(p-hthalic anhydride) and various diamines, with the intention of having a no. of F/H and sym./asym. analog sets. Since several of the fluorinated diamines were exceptionally unreactive, a multistep polycondensation polymn. technique was developed to obtain materials of sufficient mol. wt. for property evaluation. Effects of F incorporation on the aforementioned properties are reported.

IT 143154-89-6P

(prepn. and properties of)

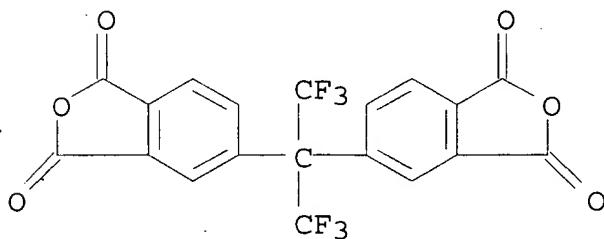
RN 143154-89-6 ZCA

CN 1,3-Isobenzofurandione, 5,5'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]bis-, polymer with 3,3'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2

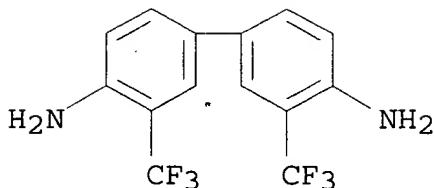
CMF C19 H6 F6 O6



CM 2

CRN 346-88-3

CMF C14 H10 F6 N2

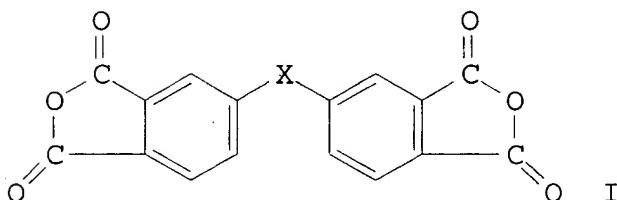


IT 143154-89-6P

(prepn. and properties of)

L32 ANSWER 14 OF 14 ZCA COPYRIGHT 2003 ACS  
 117:113674 Low viscosity aromatic polyimide varnishes for smooth electric insulators. Shimanoki, Hisae; Okabe, Yoshiaki; Miwa, Takao; Numata, Shunichi; Ikeda, Takae (Hitachi Seisakusho K. K., Japan; Hitachi Kasei Kogyo K. K.). Jpn. Kokai Tokkyo Koho JP 04077586 A2 19920311 Heisei, 8 pp. (Japanese). CODEN: JKXXAF.  
 APPLICATION: JP 1990-186379 19900713.

GI



AB The title varnishes with viscosity (A) < 0.1 P contain equal mol. of tetracarboxylic acid dianhydrides I [X = CO, SO<sub>2</sub>, C(CF<sub>3</sub>)<sub>2</sub>] and arom. diamines H<sub>2</sub>NYNH<sub>2</sub>, H<sub>2</sub>NYYNH<sub>2</sub>, H<sub>2</sub>NYYYNH<sub>2</sub>, H<sub>2</sub>NYZY'NH<sub>2</sub> [Y = C<sub>6</sub>H<sub>4</sub>-nR<sub>n</sub>; Y' = C<sub>6</sub>H<sub>4</sub>-nR'n; Y<sub>2</sub> = C<sub>6</sub>H<sub>4</sub>-nR<sub>2</sub>n; R, R<sub>1</sub>, R<sub>2</sub> = NO<sub>2</sub>, CN, acyl, mesyl, methylsulfinyl, fluoroalkyl, (fluoro)alkoxy, halogen; Z = O, CO, SO<sub>2</sub>, C(CF<sub>3</sub>)<sub>2</sub>; n = 1-4]. Thus, a 42% varnish (A 0.05 P) contg. 1:1 I [X = C(CF<sub>3</sub>)<sub>2</sub>] and 2-methoxy-1,4-diaminobenzene gave a film showing temp. for 30% loss over 100 min 485.degree., tensile strength 19.3 kg/mm<sup>2</sup>, dielec. const. 2.8, and smoothness [1-.DELTA.H/H; .DELTA.H, H = the unevenness of the film and the substrate (e.g. the printed circuit), resp.] 0.79.

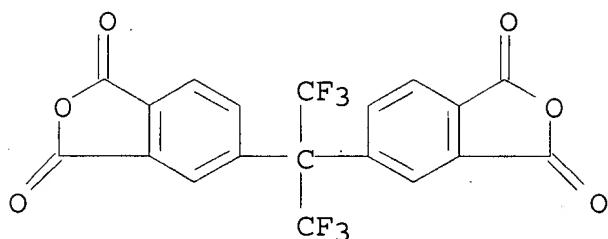
IT 143154-89-6

(low viscosity varnishes, for smooth elec. insulators)

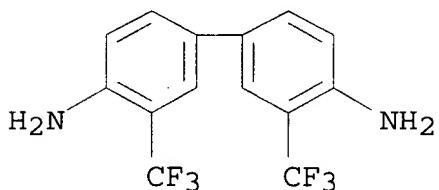
RN 143154-89-6 ZCA

CN 1,3-Isobenzofurandione, 5,5'-(2,2,2-trifluoro-1-(trifluoromethyl)ethylidene)bis-, polymer with 3,3'-bis(trifluoromethyl)[1,1'-biphenyl]-4,4'-diamine (9CI) (CA INDEX NAME)

CM 1

CRN 1107-00-2  
CMF C19 H6 F6 O6

CM 2

CRN 346-88-3  
CMF C14 H10 F6 N2

IT 143154-89-6

(low viscosity varnishes, for smooth elec. insulators)